

# 20 Years of MANPRINT 20 Lessons Learned

MANPRINT Practitioners Workshop

October 31, 2006

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# A History of Failures

## *Major U.S. Governmental Programs in Human Performance Improvement*

- 1965 – Air Force Personnel Subsystems Program Implemented
- 1968 – Navy Material Command Human Factors Program Initiated
- 1969 – Air Force Personnel Subsystems Program Cancelled
  - No evidence of effectiveness
  - Too much documentation
- 1970 – Navy Material Command Human Factors Program Cancelled
  - Admiral Rickover described Human Factors as “egg sucking...”
- 1980 – Nuclear Regulatory Commission Established Human Factors Directorate as result of Three Mile Island Accident.
- 1986 – Air Force IMPACTS Program Established
- 1990 – Nuclear Regulatory Commission Eliminated Human Factors Directorate
- 1991 - Air Force IMPACTS Program Disestablished

# Lesson 1: Institutionalization is necessary, but not sufficient

- History of failures – where doors were open temporarily
- Top levels must understand as well as open doors
- AF Personnel Subsystems example
  - **Two Great Lessons** – Too much documentation & No proof of benefits.

# Lesson 2. We don't have a product

- & we are a minority, without representation
  - Perception – we are enemy to technology
  - Perception – our only benefits are future
  - Perception – our benefits are obvious
  - Perception – our discipline should be invisible
  - But mainly, we don't have a product
    - We provide a service that must be valued by decision makers
    - Sometimes horror stories back us up



# Lesson 3: We have proof of benefits

- T- 800 Engine
- Comanche Helicopter
- Stinger Missile System
- Apache Helicopter
- Fox NBC Vehicle

# T-800 Summary

## ➤ Requirement:

- No higher aptitude
- Fewer maintenance personnel

## ➤ Manprint Objective:

- No cost clause
- Influence design

## ➤ Results:

- Org maintenance tool kit (134 tools to 6 pieces)
- Reduced highest task aptitude requirements

AA 105+	3% - 0%
AA 100+	3% - 1%
- Manpower man-hours reduced 14%
- Reliability above Army requirement

# Impact on Comanche

## **MANPRINT** **Impact on Comanche**

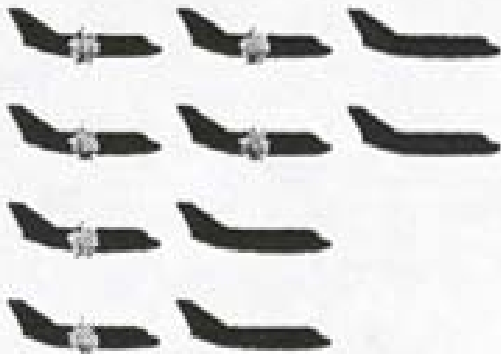


- Improved Army acquisition process (e.g., Source Selection, TSM-Forward)
- Drove human-centered design - 500 design improvements
- Maximization of total system performance (pilot workload, maintenance ease, personnel safety)
- Cost Avoidance > \$3.29B
- Avoids 91 fatalities, 116 disabling injuries



# Air Defense System Performance

DESIGNED PERFORMANCE



$$P_S = .6$$



$$P_H = 1.0$$

SUPERIOR GUNNER



$$P_S = .402$$



$$P_H = .67$$

ACTUAL PERFORMANCE



$$P_S = 0.306$$



$$P_H = .51$$



# Fox Summary

## **FOX MPT-HFE BENEFITS**

- Demonstrated usefulness of HSI modeling for ACAT III programs.
- Showed importance of Human Figure Modeling for workload design in reduced manpower situations.
- Demonstrated method of combining different HSI modeling techniques for achieving program missions.
- Confirmed investment cost of HSI low.
- Confirmed HSI modeling fast response (4 months) for short program schedules.
- Demonstrated major cost savings to PM (\$2-4M) in 1 year.
- Demonstrated HSI can save small programs.

# Cost Benefits Summary

## Major Returns on Investment

System	Cost Avoidance (CA)	Investment (I)	$\frac{CA}{I}$ Ratio	Time (yrs)
Comanche	\$3.29B	\$74.9M	43.9:1	20
Apache Longbow	\$268.8M	\$12.3M	21.8:1	20
Fox	\$2-4M	\$60K	33.0:1	1

# Lesson 4: We don't have enough examples

- Examples are all Army
- Examples are old
- Good examples are difficult to document
- Good examples are costly



# Lesson 5: Progress is difficult to assess

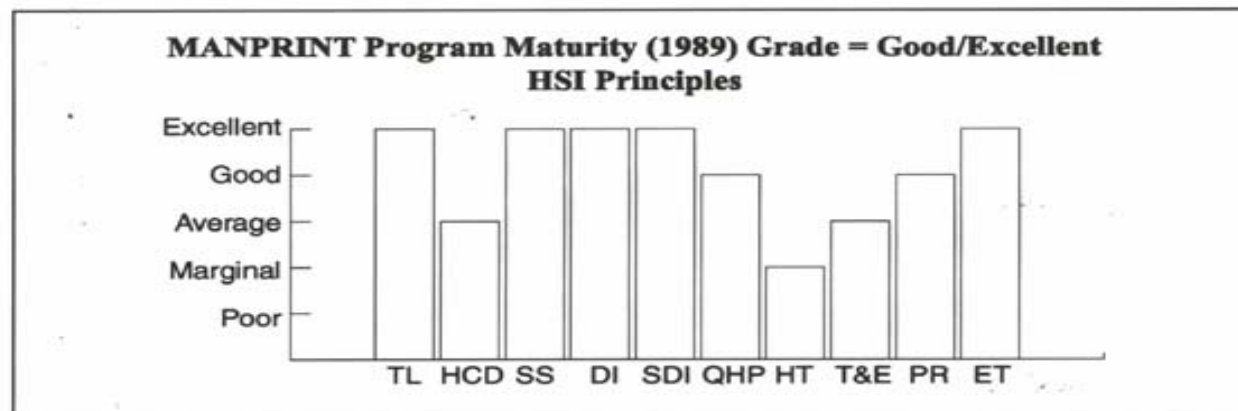
- But we have useful principles
  - 10 principles of MANPRINT/HSI
  - Can apply to organizations & systems
  - Are correlated, but each unique
  - All principles are needed; Just one weak principle can weaken program
  - Show MANPRINT up and down over time

# Ten HSI Principles

1. Top level understanding and advocacy
2. Human Centered Design ("Systems" include humans)
3. Source Selection policy
4. Organizational integration of all "human factors" domains
5. Documentation integration of HSI into acquisition process
6. Quantification of human parameters
7. Application of HSI Technology
8. Test & Evaluation integrated with HSI
9. Highly qualified HSI practitioners
10. Broad HSI education and training program

# Army HSI Program Maturity - 1989

## US Army MANPRINT Program Maturity



Excellent = Best in Class, fully mature, example for others  
 Good = Very well developed, but room for improvement  
 Average = Developing quality in some areas, but weak in others  
 Marginal = Some signs of growth, but generally immature  
 Poor = Does not exist at all, or poorly formulated

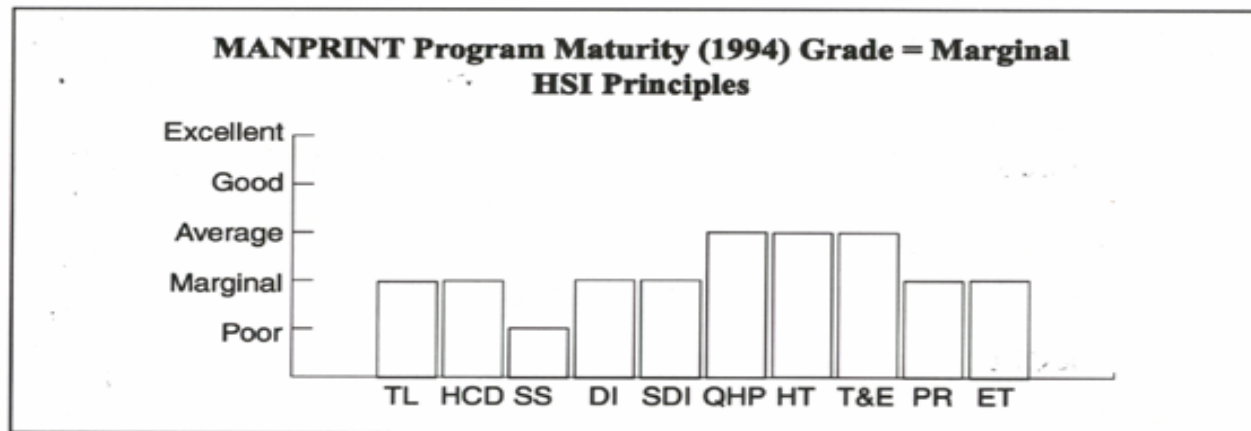
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TL = Top Level Leadership  
 HCD = Human Centered Design  
 SS = Source Selection  
 DI = Domain Integration  
 SDI = Documentation Integration  
 QHP = Quantification of Human Parameters  
 HT = HSI Technology  
 TE = Test and Evaluation  
 PR = Qualified Practitioners  
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# Army HSI Program Maturity - 1994

## US Army MANPRINT Program Maturity



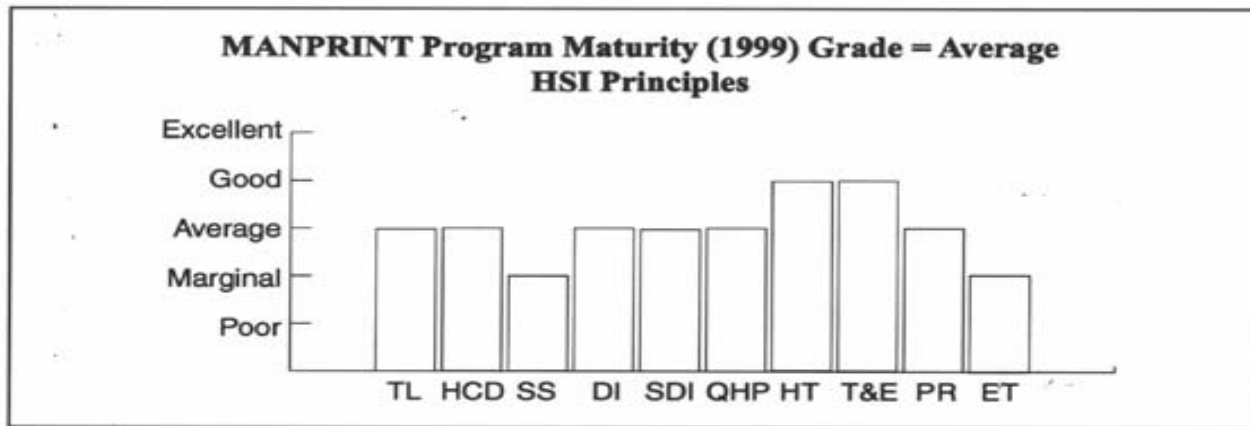
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# Lesson 6: Organizational integration is necessary, but difficult to achieve

- Common focus provides demonstrable results
- Domains can legitimately work at cross purposes
- In times of stress, organizations return to home base



# Lesson 7: We are a power to be reckoned with:

## ➤ When

- We can kill a program
- We save a program
- Contractor wins or loses because of MANPRINT

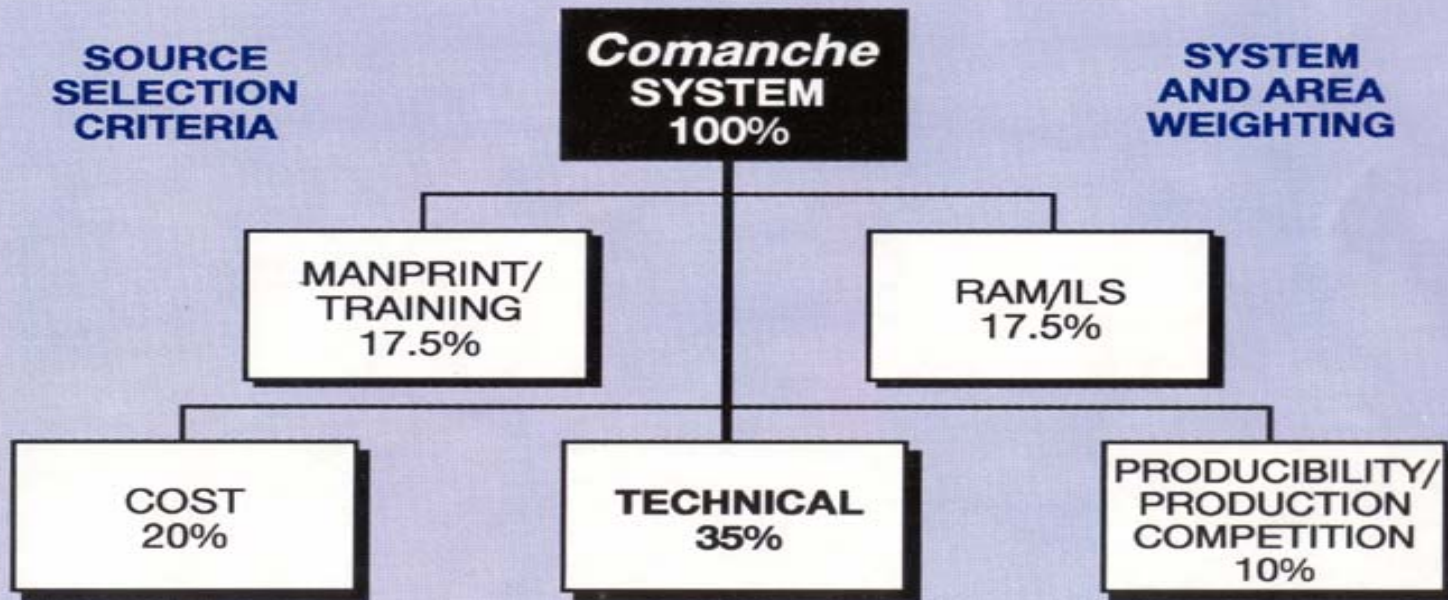
# Lesson 8: Industry must have incentives

- Industry must win or lose based on MANPRINT
- Industry success does not transfer easily (even within same company)
- Industry does not create skilled practitioners (but this can and should change)
- Industry is quick to learn, quick to forget

# MANPRINT in Source Selection

## MANPRINT in Source Selection

DEM/VAL PROTOTYPE AND FULL SCALE DEVELOPMENT



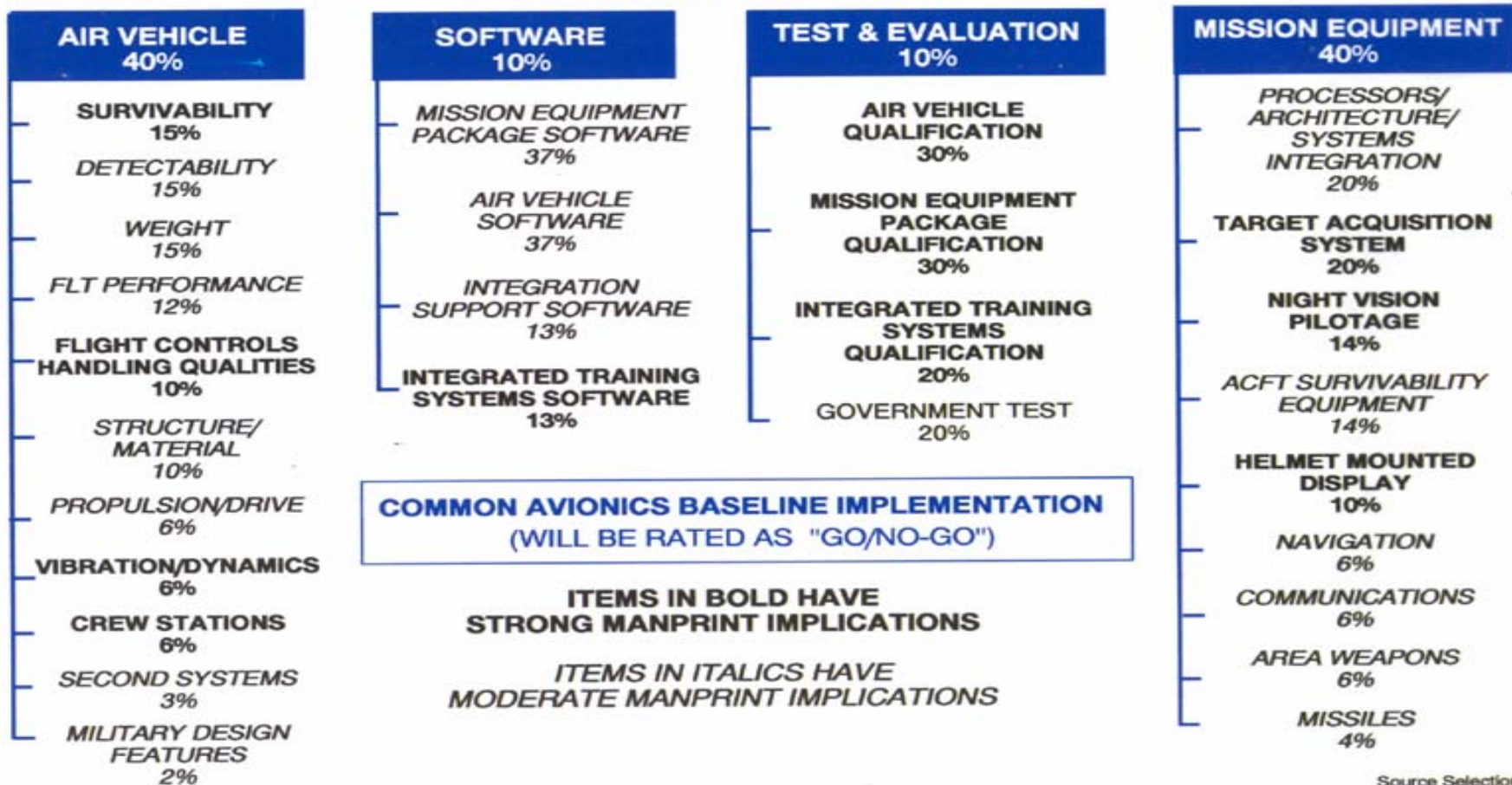
MP in source select (I)



# Source Selection Evaluation Criteria

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### TECHNICAL - 35%





# Lesson 9: Industry can be extremely creative

- T-800

- Comanche

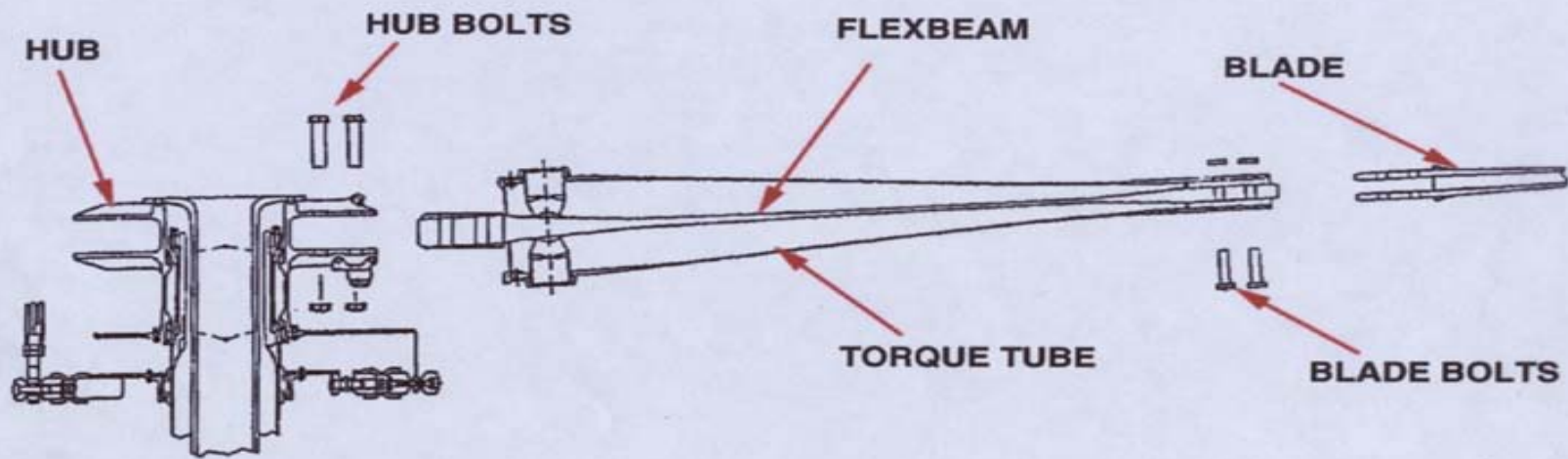
# T-800 Tool Kit



421852

# Pentaflex - After

## Modular Pentaflex Blade Removal

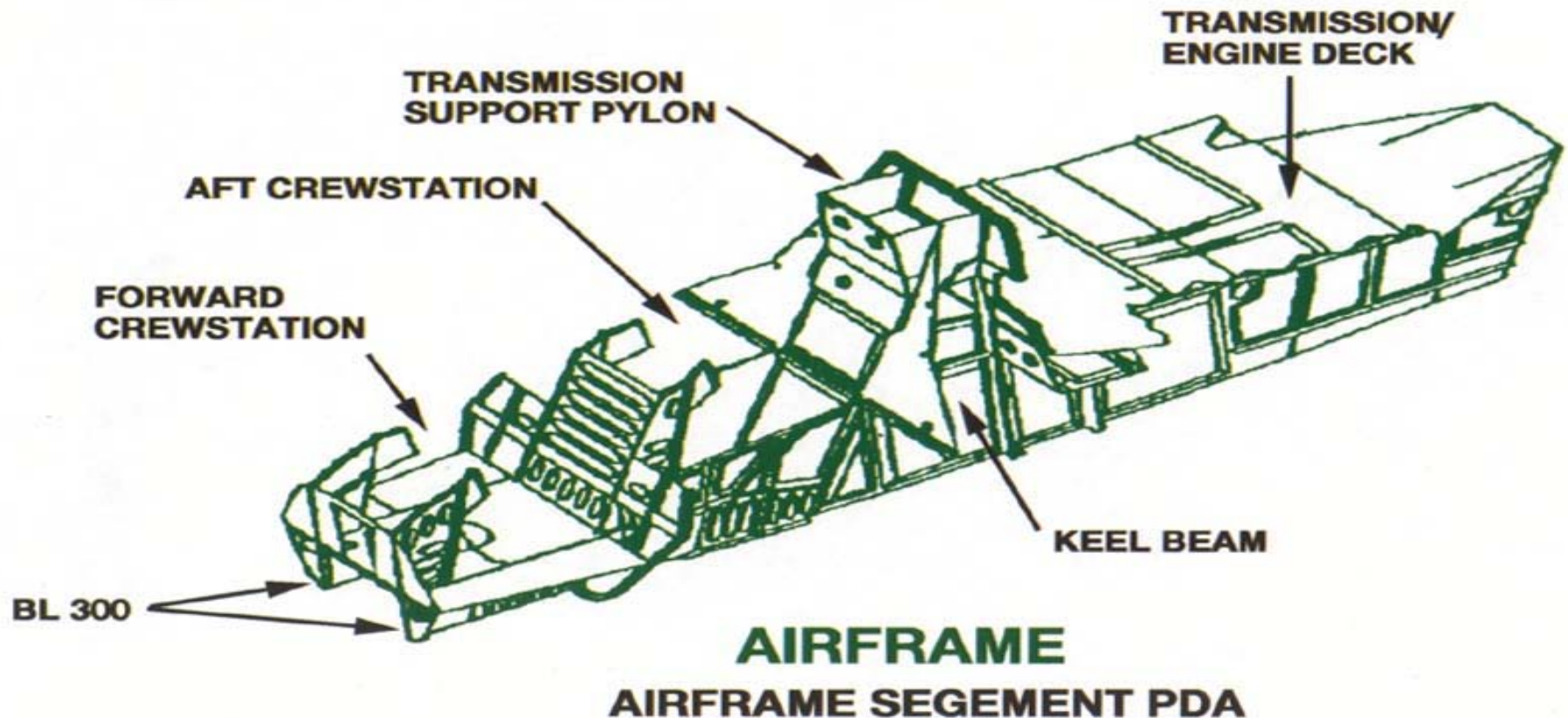




# Box Beam

## CENTER BOX BEAM

PROVIDES PRIMARY STRUCTURAL LOAD PATH





# Lesson 10: Tools exist that aid integration

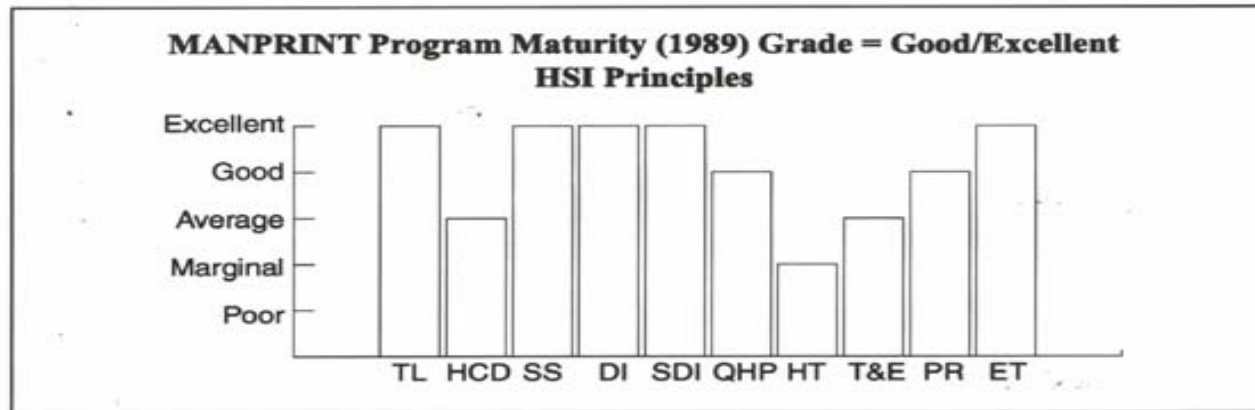
- Chapter 11-16 of HSI Handbook – 2003
- Tools, Techniques, and Technology Seminar 2000
- Presentations at this workshop

# Lesson 11: Tools progress even in hard times

- Principle for HSI technology improves with time
- HSI Tools are needed to make other Military technologies work

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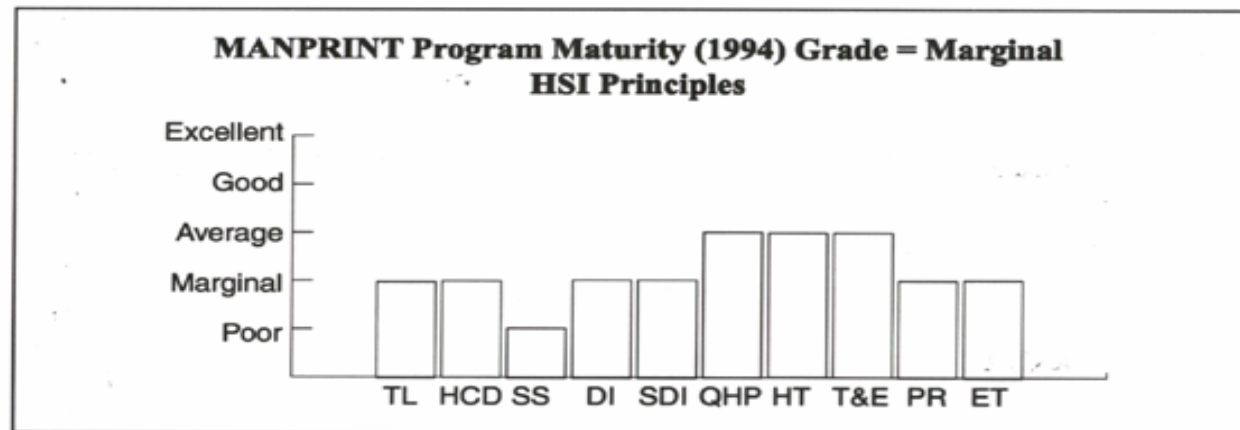
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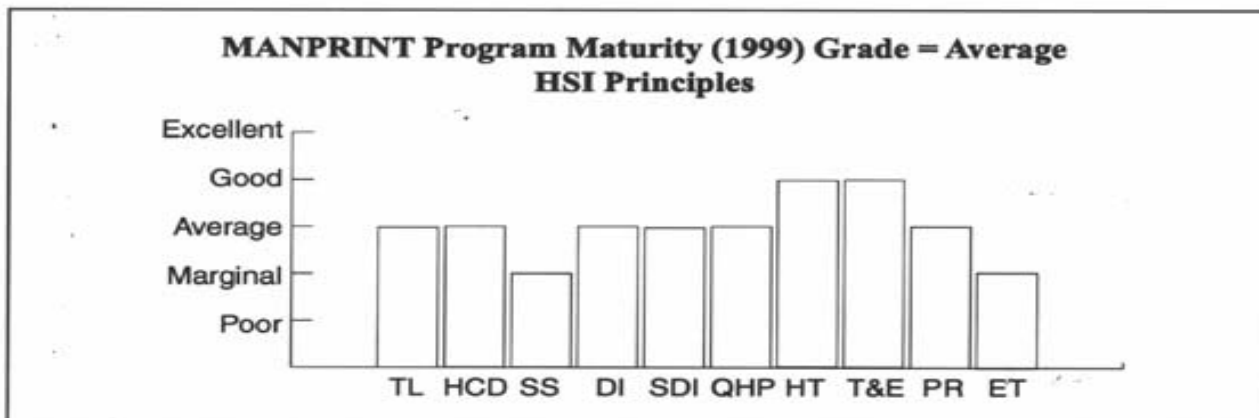
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# Lesson 12: Tools can help with analysis, and change MANPRINT work,

- But should not be used to justify reduced MANPRINT workforce
  - Tools require greater skills, not less
  - Tools are tools, not analysts

# Lesson 13: Tools still need improvements

- DOD position in ongoing Congressional study, but
- Frequent questions:
  - Is "T" ever considered in MPT tradeoffs?
  - Do MANPRINT analyses actually effect acquisition decisions?
  - Is there a tool to do cost benefits analysis for MANPRINT?

# Lesson 14: Research in Human Factors needs applications in mind

- HFES concerns and recommendations
  - Marvin Dainoff – HFES President
    - Comments in HFES Bulletin, Feb. 2006 and Sept. 2006



# Lesson 15: MANPRINT is major hope for assuring future military objectives are achieved

- Where else can we hope to find a means which allows MPT costs to go down, while system performance, safety, health, and survivability go up?
- MANPRINT can be a creative thrust for technology

# Lesson 16: MANPRINT/HSI Workforce is inadequate

- Insufficient numbers, government and industry, to meet future hopes
- Insufficient skills available for anticipated future demand

# Lesson 17: Need a full education and training program for an HSI field

- Need to educate and train more people with greater skills
- Need to educate the world on benefits
- Need a career field for HSI
  - To truly institutionalize MANPRINT/HSI



# Lesson 18: Human Factors Academic Institutions Need to Change

- To focus upon HSI
  - HFES recommendations
  - Feedback from Joint study on certification
  - Reclaim original intent of DOD in supporting Human Factors

# Lesson 19: MANPRINT/HSI must keep growing conceptually

- Socio-technical Systems Concept
- Requires pull from outside U.S. DOD as well as push from within.

# Socio-technical Systems

## Sociotechnical Systems—Levels of Complexity by Mission Areas

Sociotechnical Systems	Mission Areas			
	Military	Health Care	Energy	Transportation
<b>A. Very Highly Complex Organizations</b> <ul style="list-style-type: none"> <li>• Governmental Agencies</li> <li>• Unpredictable Environments</li> </ul>	Army Department Warfighting Units		DOE	DOT
<b>B. Highly Complex Organizations</b> <ul style="list-style-type: none"> <li>• Procurement/Regulation Agencies</li> <li>• Product/Service Organizations</li> </ul>	DoD Acquisition Large Contractors	FDA Hospitals	Nuclear Reg. Com. Nuclear Power Plant	FAA, FHA
<b>C. Complex Organizations</b> <ul style="list-style-type: none"> <li>• System of Systems</li> </ul>	Aircraft Carrier	Emergency Room		
<b>D. Major Technological System</b>	Aircraft, Tank, Command & Control		Power Generator Control Room	Train, Car ATC Room
<b>E. Critical Technological Subsystem</b>	Aircraft Cockpit		Controls/Displays	ATC Console
<b>F. Small Systems/Devices</b> [System Parts]	Radio, Radar [Engine, Wings]	MRI, Monitors [Tubes, Cables]	Feed Water Pump [Steam Pipes]	Bicycle [Tires]



# Lesson 20: MANPRINT would be dead already, if not doing something right.

- This year is 20th birthday of MANPRINT and it is still alive and well.
- We believe it is still young, maybe will live to be 100.